Burlington County College

Prepared For:
Burlington County College
Pemberton, NJ Campus

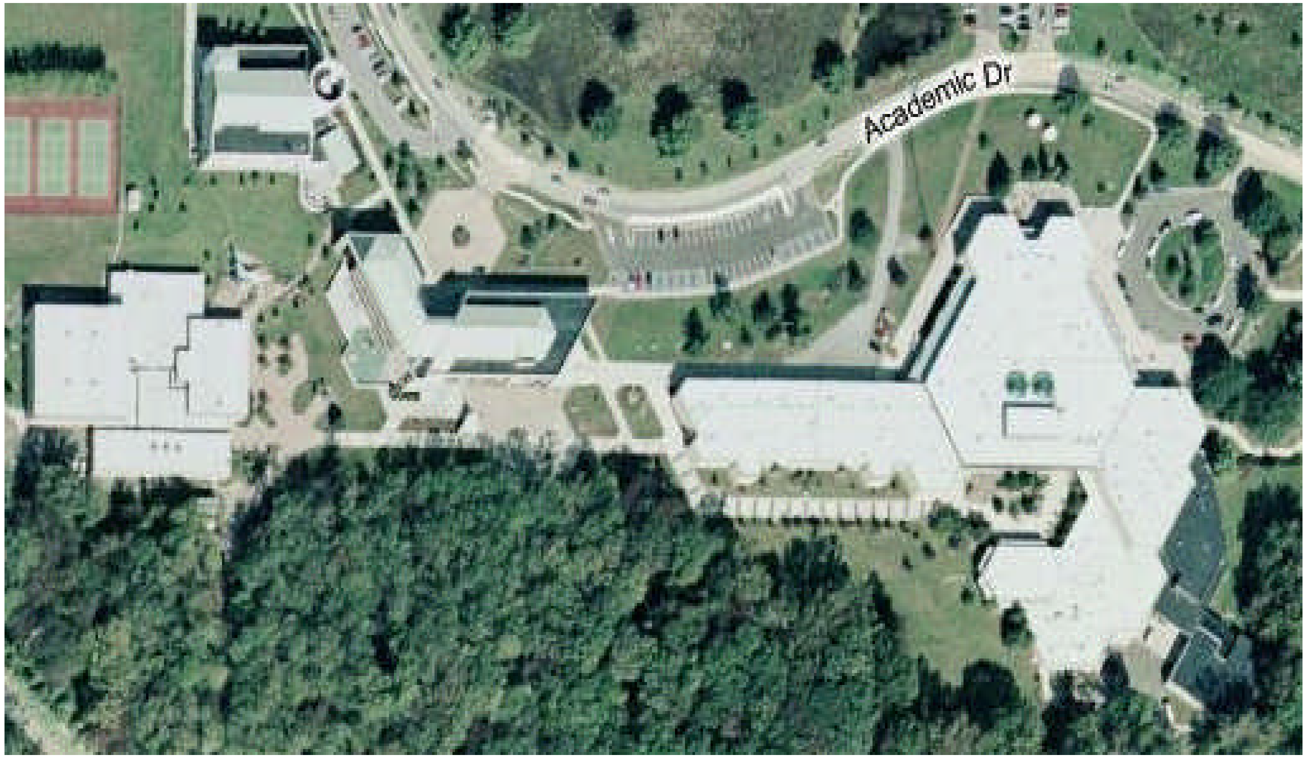
Jay Falkenstein
Physical Plant Manager

Prepared By:
Dome – Tech, Inc.

Prepared Under the Guidelines of the State of NJ Local Government Energy Audit Program

September 2009

Energy Audit



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BURLINGTON COUNTY COLLEGE
ENERGY AUDIT REPORT
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October 1, 2009

Mr. Jay Falkenstein
Physical Plant Manager
Burlington County College
601 Pemberton Browns Mills Road
Pemberton, NJ 08068

RE: EXECUTIVE SUMMARY FOR BURLINGTON COUNTY COLLEGE STATE OF NEW JERSEY LOCAL GOVERNMENT ENERGY AUDIT

Dear Mr. Falkenstein:

Dome-Tech was retained by Burlington County College, as a pre-qualified participant in the New Jersey Local Government Energy Audit Program, to perform an energy audit of the College's Pemberton, NJ campus. The objective of the energy audit was to evaluate the energy consumption of the college's buildings, establish baselines for energy efficiency and identify opportunities to reduce the amount of energy used and/or its cost.

The scope of the audit is standardized under the Program, and consisted of the following:

- Benchmarking historic energy consumption utilizing EPA Energy Star's Portfolio Manager
- Characterizing building use, occupancy, size, and construction
- Providing a detailed equipment list including estimated service life and efficiency
- Identifying energy conservation measures
- Evaluating the economic viability of various renewable/distributed energy technologies
- Performing a utility tariff analysis and assessing savings potential from energy procurement strategies
- Providing the method of analyses

Based on the data analyzed for the period of February 2008 through February 2009, Burlington County College has an annual energy expenditure of:

- Electricity: 6,007,640 kWh at a total cost of $973,079
- Natural Gas: 265,440 therms at a total cost of $425,329

Please refer to Section 2 of this report for a detailed list of identified Energy Conservation Measures (ECMs), along with a summary of their preliminary economics (estimated project cost, estimated annual energy savings, applicable rebate(s), etc.). In this report, all identified ECM's are ranked and presented according to their simple payback; however, please note that the master ECM table can also be sorted by building, by measure type, by cost, etc.

If all identified ECM's were to be implemented, they would provide the following estimated benefits to Burlington County College:

- Total annual electrical savings: 1,328,330 kilowatt-hours; 22.1%
- Total annual natural gas savings: 81,745 therms of natural gas usage; 30.8%
- Total annual energy cost savings: $363,600; 26%

- Total annual CO_2 emissions reduction: 917 tons
- Total estimated gross implementation cost: $4,295,000
- Total avoided cost (like in kind replacement): $1,465,000
- Total Rebates/Incentives: $66,670
- Total Net Implementation Costs: $2,760,000
- Total average simple payback: 7.5 yrs

Based on a variety of factors such as economics and/or technical viability, these projects are recommended for implementation: re-programming CFM setpoints, replacing chillers, lowering the pool water temperature, replacing boilers, replacing unit heaters with infrared radiant heaters, installing premium efficient motors, upgrading lighting, installing a ground-mounted solar photovoltaic system, and implementing an energy awareness program.

Although not considered an energy conservation measure, Dome-Tech recommends installing electric, chilled water and hot water sub-meters in each of the buildings. Sub-metering provides a means to benchmark facility energy use, prioritize energy and capital projects and improve resource allocation.

Of the six buildings surveyed, none of them were applicable for submission to the ENERGY STAR Portfolio Manager rating program due to operating characteristics and or building type. Buildings with scores of 75 or higher may qualify for the ENERGY STAR Building Label.

All buildings, with the exception of 800 and 400, are served by the central plant.

Distributed/Renewable Energy Systems were reviewed for the College with the following conclusions:

- A Ground Source Heat Pump (GSHP) installation is not recommended as an immediate retrofit project. However, a detailed life cycle analysis of a GSHP system versus a traditional HVAC system is recommended once the existing equipment exceeds the estimated equipment service life.
- Dome-Tech considered three different types of wind turbine technologies that consisted of both building-mounted and traditional ground-mounted variety. Due to attractive payback and high potential for energy reduction, the 50 kilowatt ground mounted wind turbine project appears to be the most attractive option. Should Burlington County College decide to pursue a wind turbine project, Dome-Tech recommends commissioning a more detailed study.
- A ground mounted 1110 kW dc photovoltaic system that could provide 23% of the annual energy usage for the College campus was assessed for implementation.
- Combined Heat and Power (CHP), Fuel Cells, and Micro-turbines were also researched, but are not recommended due to the lack of thermal requirements in the summertime.

Regarding the procurement of utilities, Dome-Tech understands that Burlington County College is served by six (6) electric accounts behind Jersey Central Power & Light under general service secondary. Due to current market conditions, there is now an opportunity to achieve savings for BGS-FP accounts by switching to a retail energy supplier.

Burlington County College is served by two (2) natural gas meters behind Public Service Electric & Gas Company. If the College seeks longer-term rate stability, now is an ideal time to entertain it through a fixed-price arrangement with a retail supplier.

During the development of this audit, Dome-Tech was assisted by facility personnel, who were both knowledgeable and very helpful to our efforts. We would like to acknowledge and thank those individuals.

Sincerely,

Derek C. James
Senior Energy Engineer

BURLINGTON COUNTY COLLEGE ECM SUMMARY SHEET

Prepared by Dome-Tech, Inc.

ECO/ECM Summary

ECM#	Energy Conservation Measures (ECM)	Building	Energy Savings kWh	Energy Savings kW	Energy Savings Therms	Gross Installation Costs*	Gross Installation Costs*	Avoided Cost (Like In-kind Replacement)	Rebates/ Incentives	Net Implementation Costs	Annual Energy Cost Savings	Annual Operating Cost Savings	Total Annual Cost Savings	Simple Pay Back (yrs)	Annual Avoided CO2 Emissions (tons)	Return on Investment (ROI)	Lifecycle Cost Savings*
1	Reprogram CFM setpoints	Library	3,770	0	0	$ 2,880	$ 2,880	$ -	$ -	$ 2,880	$ 12,830	$ -	$ 12,830	0.2	1	N/A	N/A
2	Lower Pool H2O Temp	PE building	0	0	2,020	$ 960	$ 960	$ -	$ -	$ 960	$ 3,450	$ -	$ 3,450	0.3	12	N/A	N/A
3	Replace Unit Heaters w/ Infrared Radian heaters	Lewis Parker	0	0	10,750	$ 35,483	$ 35,480	$ -	$ -	$ 35,480	$ 18,380	$ -	$ 18,380	1.9	63	573%	$ 238,940
4	Replace Boilers	Central Plant	0	0	54,045	$ 787,942	$ 787,940	$ 605,160	$ 18,500	$ 164,280	$ 82,150	$ -	$ 82,150	2.0	316	1650%	$ 2,875,250
5	Replace Return Fan Vortex Controls w/ VFDs	Library	9,970	0	0	$ 12,561	$ 12,600	$ -	$ 1,200	$ 11,400	$ 1,580	$ -	$ 1,580	7.2	3	N/A	N/A
6	Premium Efficiency Motors	Central Plant	5,860	5	0	$ 13,709	$ 13,700	$ 10,090	$ 1,040	$ 2,570	$ 940	$ -	$ 940	2.7	2	558%	$ 16,920
7	LIGHTING	Academic	122,000	28	0	$ 60,238	$ 60,240	$ -	$ 1,300	$ 58,940	$ 18,340		$ 18,340	3.2	40	-29%	$ 41,872
7	LIGHTING	400 Building	7,320	2	0	$ 8,753	$ 8,750	$ -	$ -	$ 8,750	$ 1,100		$ 1,100	8.0	2	-71%	$ 2,511
7	LIGHTING	800 Building	39,540	9	0	$ 10,626	$ 10,630	$ -	$ 2,500	$ 8,130	$ 5,930		$ 5,930	1.4	13	67%	$ 13,539
7	LIGHTING	Library	59,900	14	0	$ 25,708	$ 25,710	$ -	$ 330	$ 25,380	$ 8,980		$ 8,980	2.8	20	-19%	$ 20,502
7	LIGHTING	Lewis Parker	63,350	63	0	$ 183,493	$ 183,500	$ -	$ 4,040	$ 179,460	$ 42,000		$ 42,000	4.3	21	-47%	$ 95,890
7	LIGHTING	PE building	112,900	26	0	$ 67,840	$ 67,840	$ -	$ 7,360	$ 60,480	$ 16,940		$ 16,940	3.6	37	-36%	$ 38,676
8	Replace Air-cooled Chiller	800 Building	54,800	36	0	$ 180,516	$ 180,520	$ 148,930	$ 1,600	$ 29,990	$ 8,770	$ -	$ 8,770	3.4	18	485%	$ 175,400
9	Replace Chillers	Central Plant	124,580	81	0	$ 801,490	$ 801,490	$ 701,490	$ 21,000	$ 79,000	$ 19,930	$ -	$ 19,930	4.0	41	480%	$ 458,390
10	Occ Sensors for UVs	Lewis Parker	58,630	0	3,880	$ 57,815	$ 57,820	$ -	$ -	$ 57,820	$ 16,020	$ -	$ 16,020	3.6	42	N/A	N/A
10	Occ Sensors for UVs	Academic	13,310	0	780	$ 64,118	$ 64,120	$ -	$ -	$ 64,120	$ 3,460	$ -	$ 3,460	18.5	9	N/A	N/A
11	Demand Control Ventilation	Library	23,590	0	1,270	$ 7,772	$ 7,770	$ -	$ -	$ 7,770	$ 3,260	$ -	$ 3,260	2.4	15	N/A	N/A
11	Demand Control Ventilation	Academic	23,590	0	1,270	$ 26,413	$ 26,410	$ -	$ -	$ 26,410	$ 1,870	$ -	$ 1,870	14.1	15	N/A	N/A
12	FCU Time of Day Optimization	PE building	8,380	0	0	$ 10,883	$ 10,880	$ -	$ -	$ 10,880	$ 1,340		$ 1,340	8.1	3	N/A	N/A
12	Unit Vent Time of Day Optimization	Lewis Parker	6,700	0	0	8706.03564	$ 8,710	$ -	$ -	$ 8,710	$ 1,070	$ -	$ 1,070	8.1	2	N/A	N/A
13	Replace Pool AHUs	PE building	35,600	0	4,160	$ 170,618	$ 170,620	$ -	$ -	$ 170,620	$ 12,810	$ -	$ 12,810	13.3	36	88%	$ 320,250
14	Replace AHUs	Lewis Parker	205,000	2	2,160	$ 342,059	$ 342,060	$ -	$ -	$ 342,060	$ 36,550	$ -	$ 36,550	9.4	80	167%	$ 913,750
15	Variable Frequency Drives - Cooling Tower Fans	Central Plant	32,470	0	0	$ 54,990	$ 54,990	$ -	$ -	$ 54,990	$ 5,200	$ -	$ 5,200	10.6	11	N/A	N/A
16	Replace FCUs	Lewis Parker	260,400	2	0	$1,183,153	$ 1,183,200	$ -	$ -	$ 1,183,200	$ 41,670	$ -	$ 41,670	28.4	86	N/A	N/A
17	VFDs on HW & CHW Pumps	Lewis Parker	41,100	0	0	$ 95,735	$ 95,740	$ -	$ 6,000	$ 89,740	$ 6,500	$ -	$ 6,500	13.8	14	N/A	N/A
18	Replace Supply Fan Vortex Controls w/ VFDs	Academic	17,940	0	0	$ 44,477	$ 44,480	$ -	$ 1,800	$ 42,680	$ 2,840	$ -	$ 2,840	15.0	6	N/A	N/A
19	Instantaneous HW - tie into new boilers w/ HX	Central Plant	0	0	1,410	$ 36,104	$ 36,100	$ -	$ -	$ 36,100	$ 2,320	$ -	$ 2,320	15.6	8	N/A	N/A
20	Evap Fan Controls - Walk-in Cooler/ Freezers	Lewis Parker	1,400	0	0	$ 3,650	$ 3,650	$ -	$ -	$ 3,650	$ 200	$ -	$ 200	18.3	0	N/A	N/A
	Totals		1,328,330	266	81,745	$ 910,895	$ 4,295,910	$ 1,465,670	$ 66,670	$ 2,763,570	$ 363,600	$ -	$ 363,600	7.6	917	13%	$ 4,759,960

Energy Audit Purpose & Scope

Purpose:

- The objectives of the energy audit are to evaluate the site's energy consumption, establish baselines for energy consumption and identify opportunities to reduce the amount of energy used and/or its cost.

Scope:

I. Historic Energy Consumption: Benchmark energy use using Energy Star Portfolio Manager

II. Facility Description – characterize building usage, occupancy, size and construction.

III. Equipment Inventory – detailed equipment list including useful life and efficiency.

IV. Energy Conservation Measures: Identify and evaluate opportunities for cost savings and economic returns.

V. Renewable/Distributed Energy Measures: evaluate economic viability of various renewable/distributed energy technologies.

VI. Energy Purchasing and Procurement Strategies: perform utility tariff analysis and assess potential for savings from energy procurement strategies.

VII. Method of Analysis: Appendices

Dome-Tech, Inc.

Historic Energy Consumption

Utility Usage and Costs Summary **Time-period: Feb. 2008 – Jan. 2009**

Buildings/Facilities	Electric			Natural Gas		
	Annual kWh	Annual Cost	$ / kWh	Annual therms	Annual Cost	$ / Therm
Lewis Parker Building	2,581,600	$407,048	$0.16	*NA*	*NA*	*NA*
PE building & Central Plant	1,576,800	$271,347	$0.17	247,431	$392,125	$1.58
Academic Building	658,720	$105,575	$0.16	*NA*	*NA*	*NA*
Integrated Resource	849,600	$132,402	$0.16	*NA*	*NA*	*NA*
800 Building -Police Academy	278,120	$46,112	$0.17	*NA*	*NA*	*NA*
400 Building - Maintenance	62,800	$10,595	$0.17	*NA*	*NA*	*NA*
East Campus *(Gas is not submetered)*	*NA*	*NA*	*NA*	18,009	$33,204	$1.84
TOTALS	**6,007,640**	**$973,079**	**$0.16**	**265,440**	**$425,329**	**$1.71**

Please see Appendix for full utility data and consumption profiles for all Buildings.

Historic Energy Consumption

Dome-Tech, Inc.

ENERGY STAR SCORES

- Energy Star Score is calculated to establish a facility-specific energy intensity baseline.
- Energy Star can be used to compare energy consumption to other similar facilities and to gauge the success of energy conservation and cost containment efforts.
- Buildings with an Energy Star rating/score of 75, or above, are eligible to apply for an official Energy Star Building label.
- Energy Star scores are only applicable to certain types of buildings (i.e.: schools K-12, or dormitory buildings) and requires the buildings to be individually metered in order to get a rating. Because the facilities on the Pemberton campus are heated and cooled by a central plant (and are not sub-metered), and Energy Star Score can not be determined.

Facility Name	Total Floor Area	Energy Star Score	Eligible to Apply for ENERGY STAR	Current Site Energy Intensity (kBtu/SF)	Current Source Energy Intensity (kBtu/SF)
Lewis Parker Building	182,000	*NA*	*NA*	47.9	160
PE building & Central Plant	45,000	*NA*	*NA*	652.1	956.5
Academic Building	49,103	*NA*	*NA*	45.6	152.2
Integrated Resource	42,000	*NA*	*NA*	68.7	229.3
800 Building -Police Academy	10,375	*NA*	*NA*	87.3	291.7
400 Building - Maintenance	6,000	*NA*	*NA*	35.6	118.9
Campus - *Energy use from Natural Gas*	334,478	*NA*	*NA*	6.2	6.5

Historic Energy Consumption (continued)

Portfolio Manager Sign - In

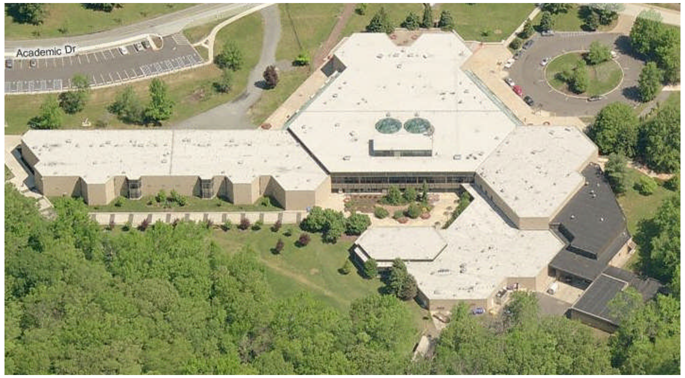
- An account has been created for Burlington County College in Portfolio Manager. You will have received an email to notify you of the generation of this account and shared access with Dome-Tech. Please use this to read your facility information. Please feel free to alter this information when the report is finalized. We would ask that you leave the sign-in information alone until then. Your college's information is currently shared as read only.
- When the report is finalized the shared access will be changed so that you can use / edit the information and change as you wish.
- Website link to sign-in: https://www.energystar.gov/istar/pmpam/index.cfm?fuseaction=login.Login

- Username: ***BurlingtonCC***
- Password: ***DTBurlingtonCC***
- Email for account: jfalkens@bcc.edu

Facility Information

- **Building Name:** **Lewis Parker**

Address:	601 Pemberton Browns Mills Road
Gross Floor Area:	182,000 sf
Year Built:	1970



- **Construction Features:**

Facade:	Brick; in good condition
Roof Type:	Flat, metal deck, white, built up asphalt, 1-5 years old, in good condition
Windows:	Covering 35% of façade, tinted, some with interior blinds/shades, in good condition
Exterior Doors:	Metal; >85% glass; in good condition
Floors:	2 Floors – majority of building, Small third floor area in the middle of the building, one floor only in portions of rear areas of the building.

- **Major Mechanical Systems**

Air Handlers / AC Systems / Ventilation Systems

- Ten (10) Trane Air Handling Units (AHUs); nine (9) Nesbitt AHUs; two (2) Trane Fan Coil Units

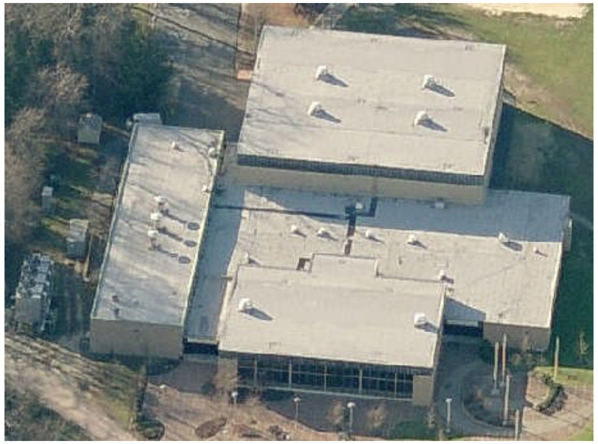
Boilers/ Heating Systems

- One (1) Aerco hot water heater

For associated pumps and motors (see equipment list)

Facility Information

- **Building Name:** **PE Building & Central Plant**



Address:	601 Pemberton Browns Mills Road
Gross Floor Area:	45,000 sf
Year Built:	1970

- **Construction Features:**

Facade:	Brick/block; in good condition
Roof Type:	Flat, metal deck, white, built-up asphalt, 1-7 years old; in good condition
Windows:	Covering < 15% of façade, fixed, metal, some glazing at pool
Exterior Doors:	Metal, < 85% glass

- **Major Mechanical Systems**

Air Handlers / AC Systems / Ventilation Systems

- Three (3) Trane Air Handling Units (AHUs); four (4) Centralaire AHUs; two (2) Nesbitt AHUs
- Two (2) York electric, centrifugal chillers
- Four (4) Baltimore Aircoil cooling towers

Boilers/ Heating Systems

- Two (2) Superior fire-tube boilers; one (1) Bryant water tube boiler; one (1) Raypak pool heater

For associated pumps and motors (see equipment list)

Facility Information

- **Building Name:** **Academic Building**

  Address: 601 Pemberton Browns Mills Rd

  Gross Floor Area: 49,103 sf

  Year Built: 1994

- **Construction Features:**

Facade:	Brick; in good condition
Roof Type:	Partially pitched, metal deck, black/green, metal at pitched portion, membrane at flat portion; in good condition
Windows:	Covering 15% of façade, fixed, metal, double glazed, with blind/shades; in good condition
Exterior Doors:	Metal, >85% glass, in good condition

- **Major Mechanical Systems**

  Air Handlers / AC Systems / Ventilation Systems

  - Two (2) Trane Air Handling Units (AHUs); twenty-six (26) Trane fan coil units; thirty-one (31) Trane fan powered boxes; twenty-three (23) Nesbitt unit ventilators; twenty (20) Greenheck exhaust fans

  Boilers/ Heating Systems

  - One (1) Polyshield domestic hot water heater

  For associated pumps and motors (see equipment list)

Facility Information

- **Building Name:** **Integrated Resource**

Address:	601 Pemberton Browns Mills Rd
Gross Floor Area:	42,000 sf
Year Built:	1997

- **Construction Features:**

Facade:	Brick; in good condition
Roof Type:	Flat, metal, black, membrane
Windows:	Fixed, metal, double glazed, approx. 12 years old
Exterior Doors:	Metal, >85% glass, approx. 12 years old, in good condition

- **Major Mechanical Systems**

Air Handlers / AC Systems / Ventilation Systems

- One (1) Trane Air Handling Unit (AHU); one (1) Trane roof top unit (RTU); one (1) Trane fan powered box

For associated pumps and motors (see equipment list)

Facility Information

- **Building Name:** **Police Academy (800)**

Address: 601 Pemberton Browns Mills Road
Gross Floor Area: 10,375 sf
Year Built: 1975

- **Construction Features:**

Facade: Metal; in fair condition
Roof Type: Slightly pitched, metal deck, membrane, approx. 34 years old, in fair condition
Windows: Covering 10% of façade, metal frame, operable at bottom (25%), double glazed, pull-down shades, in fair condition
Exterior Doors: Metal, approx. 34 years old, in fair condition

- **Major Mechanical Systems**

Air Handlers / AC Systems / Ventilation Systems

- One (1) Trane Air Handling Unit (AHU)

Boilers/ Heating Systems

- One (1) Weil McLain AHU & Radiant Heat; one (1) Polyshield domestic hot water heater

For associated pumps and motors (see equipment list)

Facility Information

- **Building Name:** **Maintenance (400)**

  Address: 601 Pemberton Browns Mills Road

  Gross Floor Area: 6,000 sf

  Year Built: 1975

- **Construction Features:**

  Facade: Wood with siding cover

  Roof Type: Slightly pitched (10%), wood shell, tan shingle

  Windows: Wood frame, double pane, operable, vertical blinds (50%)

  Exterior Doors: Solid single doors, one double door (mostly solid)

- **Major Mechanical Systems**

  Air Handlers / AC Systems / Ventilation Systems

  - Two (2) York Air Handling Units (AHUs)

  Boilers/ Heating Systems

  - One (1) Bradford White domestic hot water heater

  For associated pumps and motors (see equipment list)

Greenhouse Gas Emission Reduction

Implementation of all the ECMs will yield:

- 1,328,330 kilowatt-hours of annual avoided electric usage.
- 81,745 therms of annual avoided natural gas usage.
- This equates to the following ***annual*** reductions:

- 917 tons of CO_2;

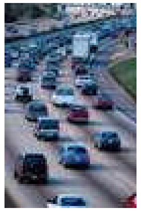
-OR-

- 239 Cars removed from road;

-OR-

- 613 Acres of trees planted annually

The Energy Information Administration (EIA) estimates that power plants in the state of Connecticut emit 0.694 lbs CO_2 per kWh generated.



The Environmental Protection Agency (EPA) estimates that one car emits 11,560 lbs CO_2 per year.

The EPA estimates that reducing CO_2 emissions by 7,333 pounds is equivalent to planting an acre of trees.

Notes and Assumptions

- Project cost estimates were based upon industry accepted published cost data, rough order of magnitude cost estimates from contractors, and regional prevailing wage rates. The cost estimates presented in this report should be used to select projects for investment grade development. The cost estimates presented in this report should not be used for budget development or acquisition requests.
- Avoided Costs (Like-In-Kind Replacement) are used for capital improvement projects that are not warranted solely based on energy savings. Therefore, avoided costs are the replacement costs for like (capacity, efficiency, etc.) equipment; it is assumed that the existing equipment will be replaced at the end of its useful life. The net implementation cost is the difference between a premium efficiency model/configuration and like-in-kind replacement.
- The following utility prices provided were used within this study:
    - Electricity Cost ($/kWh): $ 0.16
    - Natural Gas Cost ($/therm): $ 1.71
- The average CO2 emission rate from power plants serving the facilities within this report was obtained from the Environmental Protection Agency's (EPA) eGRID2007 report. It is stated that power plants within the state of NJ emit 0.66 lbs of CO2 per kWh generated.
    - The EPA estimates that burning one therm of natural gas emits 11.708 lbs CO2.
    - The EPA estimates that one car emits 11,560 lbs CO2 per year.
    - The EPA estimates that reducing CO2 emissions by 7,333 pounds is equivalent to planting an acre of trees.
- Avoided Costs (Like-In-Kind Replacement) are used for capital improvement projects that are not warranted solely based on energy savings. Therefore, avoided costs are the replacement costs for like (capacity, efficiency, etc.) equipment; it is assumed that the existing equipment will be replaced at the end of its useful life. The net implementation cost is the difference between a premium efficiency model/configuration and like-in-kind replacement.

Energy Conservation Measures
ECM #1: Reduce CFM Minimum Set Points

Library	
Estimated Savings:	$12,830
Gross Estimated Implementation Cost:	$2,880
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$2,880
Simple Payback (years):	0.2
Annual Avoided CO_2 Emissions (tons):	1

- Library CFM set points for various VAV's have no minimum airflow set point.

- Establishing and programming these set points into the BMS will reduce AHU power consumption and conditioning costs.

- Overall costs to make these changes are relatively minimal and would only require a few set point changes. The estimated costs assume controls work is not covered by existing controls contract and would not be done by in-house staff.

Note: Based on subsequent conversations with site personnel, the set points on the first floor have been changed as recommended above.

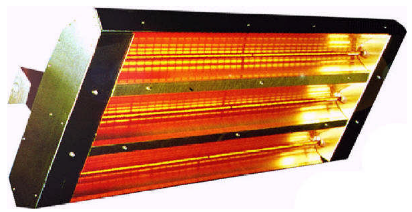
ECM #2 – Lower Pool Water Temperature

Physical Education	
Estimated Annual Energy Cost Savings:	$3,450
Gross Estimated Cost:	$960
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$960
Simple Payback (years):	0.3
Annual Avoided CO_2 Emissions (tons):	12

- Due to the temperature difference between the pool water (86°F) and ambient air (74°F), the pool experiences a significant amount of heat loss and pool water evaporation.
- Lowering the pool water temperature to space temperature will significantly reduce heating costs by minimizing the heat loss.

ECM #3: Replace Hot Water Fan Coil Units with Gas Radiant Heaters

Lewis Parker	
Estimated Annual Savings:	$18,380
Gross Estimated Implementation Cost:	$35,480
NJ Rebate:	$0
Net Estimated Implementation Cost:	$35,480
Simple Payback (years):	1.9
Annual Avoided CO_2 Emissions (tons):	63



- The shipping and receiving department and warehouse in Lewis Parker Building currently has hot water fan coil units that provide heat for workers. Maintaining a conditioned environment using convective-type heating in a low occupancy and relatively high volumetric space can be costly.
- Consider replacing the existing steam unit heaters with direct gas-fired radiant unit heaters.
- Radiant heaters eliminate convective heat loss and thermal stratification by directly heating surfaces and people rather than volumetric air.
- Direct fired radiant heaters have much lower maintenance requirements than the current fan coil units.

ECM #4: High Efficiency Boilers

- The Central Plant currently has two (2) 14 MMBtu Superior fire-tube boilers and one (1) 17 MMBtu Bryan water-tube boiler.

- The Superior boilers are 40 years old and are nearing the end of the equipment service life (ASHRAE states the service life of similar equipment to be 25 years). Furthermore, the boilers were modified from a 4-pass boiler to a 2-pass boiler. This scenario leads to reduced heat transfer and lower thermal efficiency. The Bryan flex tube boiler is currently being used to provide the heating hot water base load.

- The boiler's age, size, type and configuration of the boilers do not lend themselves to cost-efficient operation.

- If the existing boilers were replaced with high efficiency gas-fired condensing boilers, significant natural gas savings will be incurred. In modular boiler applications, multiple smaller boilers are installed to meet the overall building load. Each boiler operates independently, eliminating the "all on/all off" operation of single burner boilers. As building load increases only those units necessary to meet the load are fired. This allows each unit to run at optimal efficiency.

- The high first cost of a new boiler system preclude this ECM from being justified by economics alone. However, reliability issues warrant consideration of this project as part of a long-term capital improvement plan. Installation of a new boiler would allow boiler runtimes to be equally distributed and would allow for reliable backup capacity should one boiler fail or require repairs.

ECM #4: High Efficiency Boilers (continued)

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- High efficiency boilers should be considered when the existing boilers near the end of their useful equipment lives. The following savings and economics are based on replacing one of the two Superior boilers.

Central Plant	
Estimated Annual Energy Cost Savings:	$82,150
Gross Estimated Implementation Cost:	$787,940
Costs for Like In-Kind Replacement:	$605,160
NJ Smart Start Rebate:	$18,500
Net Incremental Implementation Cost:	$164,280
Simple Payback (years – based on Incremental cost):	2.0
Annual Avoided CO_2 Emissions (tons):	316

NOTE: Costs for Like-In-Kind Replacements are used for capital improvement projects that are not warranted solely based on energy savings. It is assumed that the existing equipment will be replaced at the end of its useful life. The net incremental implementation cost is the difference between a premium efficiency model/configuration and like-in-kind replacement.

ECM #5: Convert Return Fan Vortex to VFD

Library	
Estimated Savings:	$1,580
Gross Estimated Implementation Cost:	$12,600
NJ Smart Start Rebate:	$1,200
Net Estimated Implementation Cost:	$11,400
Simple Payback (years):	2.0
Annual Avoided CO_2 Emissions (tons):	3

- The return fan supplies air to a VFD controlled variable air volume air handler. Return air flow is controlled by vortex dampers located at the fan. However, the vortex dampers currently remain open because the compressed air system serving the pneumatic controller does not typically run. The main use of the air compressor is the mechanical humidification system, which is not typically operated.

AHU-1 Return Fan in Library

- Vortex fan control is an effective and energy-efficient method of controlling fan air flow when operable. However, controlling fan speed with a variable frequency drive will improve control, reduce the need for compressed air and provide twice the energy savings.

- This requires replacement of the motor as well as installation of a VFD. Savings include upgrading motors to high efficiency models.

ECM #6: Premium Efficiency Motors

Central Plant	
Estimated Annual Energy Savings:	$940
Gross Estimated Implementation Cost:	$13,700
Costs for Like In-Kind Replacement:	$10,090
NJ Smart Start Rebate:	$1,040
Net Estimated Implementation Cost:	$2,570
Simple Payback (years – based on incremental costs):	2.7
Annual Avoided CO_2 Emissions (tons):	2

- Most of the existing hot water and chilled water pump motors are nearing the end of their useful lives and are standard efficiency motors. See the appendix for a detailed list of motors surveyed for this ECM.
- When the motors start to fail, Dome-Tech recommends replacing them with new premium efficiency motors. The new motors would reduce the electrical consumption of the buildings' motors by approximately $1,000/year.

Typical Efficiencies for Standard & Premium Motors
(1800 RPM Open Drip-Proof Motors)

Motor Size (hp)	No. Of Motors	Existing Efficiency (%)	Premium Efficiency (%)
5	2	81.5	89.5
30	1	87.5	94.0
40	1	88.5	94.0
50	2	91.0	94.5
75	1	90.0	95.0

NOTE: Costs for Like-In-Kind Replacements are used for capital improvement projects that are not warranted solely based on energy savings. It is assumed that the existing equipment will be replaced at the end of its useful life. The net incremental implementation cost is the difference between a premium efficiency model/configuration and like-in-kind replacement.

ECM #7: Lighting Upgrade

Estimated Annual Energy Cost Savings:	$93,300
Gross Estimated Implementation Cost:	$356,650
NJ Smart Start Rebate:	$15,500
Net Estimated Implementation Costs:	$341,100
Simple Payback (yrs): (with rebate)	3.1
Annual Avoided CO_2 Emissions (tons):	133

- Although most of the current light fixtures have higher efficiency T-8 fluorescent lamps and ballasts, improved light fixture designs will further reduce lighting energy costs by reducing the total number of lamps and fixtures while maintaining the minimum lighting output as per state codes.

- Many areas were observed to have lights on regardless of occupancy. Installing occupancy sensors in these areas will automatically turn lights on/off according to actual occupancy by sensing the presence of people in the room. Occupancy sensors will reduce lighting energy costs by approximately 30%*.

*Source: Turner, Wayne, Energy Management Handbook, 1999.

ECM #8: Replace Air-Cooled Chiller

800 Building	
Estimated Annual Energy Savings:	$8,770
Gross Estimated Implementation Cost:	$180,500
Costs for Like In-Kind Replacement:	$148,930
NJ Smart Start Rebate:	$1,600
Net Incremental Implementation Cost:	$29,990
Simple Payback (years – based on incremental costs):	3.4
Annual Avoided CO_2 Emissions (tons):	18

NOTE: Costs for Like-In-Kind Replacements are used for capital improvement projects that are not warranted solely based on energy savings. It is assumed that the existing equipment will be replaced at the end of its useful life. The net incremental implementation cost is the difference between a premium efficiency model/configuration and like-in-kind replacement.

- The 800 Building's air-cooled chiller is over 15 years old, which is nearing its estimated equipment service life of 20 years per ASHRAE standards.
- Replacing the existing chiller with a water-cooled chiller and cooling tower will improve reliability, reduce downtime and significantly improve operating efficiency. A new water-cooled screw chiller has an estimated efficiency of 0.7 kilowatts per ton of cooling; the existing chiller has an estimated efficiency of 1.5 kilowatts per ton of cooling.
- The high first cost of a new chiller and cooling tower prevents this ECM from being justified by economics alone. However, reliability issues warrant consideration of this project as part of a long-term capital improvement plan.

Air-Cooled Reciprocating Chiller - 800 Building

ECM #9: Replace Main Chillers

- Burlington County College currently has two (2) York centrifugal chillers providing chilled water to all major buildings on campus. The age of these machines ranges from 15 years to 39 years old. (As per ASHRAE, centrifugal chillers have an estimated equipment service life of 23 years.)

- Replacing the centrifugal chillers in the Central Plant buildings with modern, high-efficiency water-cooled electric centrifugal chillers will significantly reduce the College's annual operating costs in several ways:
  - Lower energy consumption for cooling, and,
  - Reduce annual maintenance costs.

- The cost per ton of cooling for the existing absorption chillers is approximately $0.128 while the cost per ton for modern high efficiency centrifugal chillers is approximately $0.088, or over 30% less than the current operating scenario.

ECM #9: Replace Main Chillers (continued)

Central Plant	
Estimated Annual Energy Savings:	$19,930
Gross Estimated Implementation Cost:	$800,000
Costs for Like In-Kind Replacement:	$700,000
NJ Smart Start Rebate:	$21,000
Net Incremental Implementation Cost:	$79,000
Simple Payback (years – based on incremental costs):	4.0
Annual Avoided CO_2 Emissions (tons):	41

NOTE: Costs for Like-In-Kind Replacements are used for capital improvement projects that are not warranted solely based on energy savings. It is assumed that the existing equipment will be replaced at the end of its useful life. The net incremental implementation cost is the difference between a premium efficiency model/configuration and like-in-kind replacement.

ECM #10: Unit Ventilator Occupancy Sensors

	Academic Building	Lewis Parker	TOTALS
Estimated Annual Energy Savings:	$3,460	$16,020	**$19,480**
Gross Estimated Implementation Cost:	$64,120	$57,820	**$121,940**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$64,120	$57,820	**$121,940**
Simple Payback (years):	18.5	3.6	**6.3**
Annual Avoided CO_2 Emissions (tons):	9	42	**51**

- After review of the building layout and occupancy schedules an opportunity to install occupancy sensors on 22 unit ventilators and 26 fan coil units throughout the facility has been revealed.

- The installation of occupancy sensors will allow unit operation based on room occupancy rather than building occupancy. This will reduce the overall unit run time, further reducing heating and cooling costs.

ECM #11: Demand Control Ventilation

	Academic Building	Library	TOTALS
Estimated Annual Energy Savings:	$1,870	$3,260	**$5,130**
Gross Estimated Implementation Cost:	$26,410	$7,770	**$35,180**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$26,410	$7,770	**$35,180**
Simple Payback (years):	14.1	2.4	**6.9**
Annual Avoided CO_2 Emissions (tons):	15	15	**30**

- Building codes require that a minimum amount of fresh air be provided to ensure adequate air quality. To comply, ventilation systems often operate at a fixed rate based on an assumed occupancy (e.g., 20 cfm per person multiplied by the maximum design occupancy). The result is excessive fresh air volumes which require costly (and unnecessary) conditioning.

- Demand-controlled ventilation controls the amount of outside air based upon the CO_2 levels generated by building occupants. Demand ventilation should be added to any return air system where space occupancy varies dramatically – the lobby/hallways in the Academic building (AHU-2, 6 & 9) and the Library (AHU-1).

- By installing CO_2 sensors and controlling the CO_2 level at less than 1000 PPM, the outside air flow is kept to the absolute minimum while space conditions are kept in compliance with building codes and standards such as the ASHRAE Indoor Air Quality Standard.

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ECM #12: UniVent / FCU Time of Day Optimization

	Lewis Parker	PE Building	TOTALS
Estimated Annual Energy Savings:	$1,070	$1,340	**$2,410**
Gross Estimated Implementation Cost:	$8,710	$10,880	**$19,590**
NJ Smart Start Rebate:	$0	$0	**$0**
Net Estimated Implementation Cost:	$8,710	$10,880	**$19,590**
Simple Payback (years):	8.1	8.1	**8.1**
Annual Avoided CO_2 Emissions (tons):	2	3	**5**

- A review of the building management system (BMS) revealed an opportunity to install controls and implement a time of day schedule for several unit ventilators and fan coil units.

- Creating schedules to reflect actual building occupancy will reduce heating and cooling costs. Unit ventilators currently have no automated control and run continuously.

		Proposed Schedule	
Units	Building	Start	Stop
UV 23-26	Parker	6:00	20:00
FCU 1-5	Phys Ed	6:00	20:00

ECM #13: Replace Pool AHUs

Physical Education	
Estimated Annual Energy Savings:	$12,810
Gross Estimated Implementation Cost:	$170,600
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$170,600
Simple Payback (years):	13.3
Annual Avoided CO_2 Emissions (tons):	36

- The two (2) existing Nesbitt heating and ventilation units (HV units) serving the pool are at or near their estimated equipment service life (EESL) per ASHRAE standards (23 years.)
- These units are manually controlled. This scenario typically leads to higher operating costs when compared to units equipped with automated controls.
- Replacing these units with modern AHU's equipped with glycol heat recovery coils and hot water coils, high efficiency fans and controls will significantly reduce HVAC operating costs.

Pool HV unit w/ hot water heating coil

ECM #14: Air Handler Unit Replacement

	Lewis Parker
Estimated Annual Savings:	$36,550
Gross Estimated Implementation Cost:	$342,060
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$342,060
Simple Payback (years):	9.4
Annual Avoided CO_2 Emissions (tons):	80

- The existing air handling units (AHU's) in the D-Block of Lewis Parker Building are well past their estimated equipment service life (EESL) per ASHRAE standards. (The EESL for air handling units is 15 years.)
- Furthermore, these units are manually controlled because the pneumatic controls system was abandoned some time ago. Manually controlling on/off, chilled/hot water valves and economizers typically does not result in the most efficient operation.
- Replacing these AHU's with new, higher efficiency and fully controlled units will significantly reduce annual energy and maintenance costs.

Air Handler Unit in D-Block of Lewis Parker Bldg.

ECM #15: Cooling Tower Fan VFD

Central Plant	
Estimated Annual Energy Savings:	$5,200
Gross Estimated Implementation Cost:	$54,990
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$54,990
Simple Payback (years):	10.6
Annual Avoided CO_2 Emissions (tons):	11

- The cooling tower is equipped with four (4) 20 HP fans.
- The system currently has one fan on a VFD. The first cell fan speeds up with increasing condenser water temperature until set point is no longer maintained. At this point subsequent fans will start based on condenser water temperature.
- Dome-Tech recommends installing variable frequency drives (VFD's) on the remaining fan motors, and controlling the fan speeds based upon condenser water temperature. The fan speed is proportional to the cubed root of the required power. In other words, 50% fan speed will require 13% of the full load power.

ECM #16: Fan Coil Unit Replacement

Lewis Parker	
Estimated Annual Savings:	$41,670
Gross Estimated Implementation Cost:	$1,180,000
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$1,180,000
Simple Payback (years):	28.3
Annual Avoided CO_2 Emissions (tons):	86

- There are approximately ninety (90) existing fan coil units in the Lewis Parker Building that are at the end of their estimated equipment service life (EESL).
- The existing units are manually controlled. This scenario can lead to inefficient operation and excessive energy consumption.
- Replacing these fan coil units with new, fully controlled units will significantly reduce annual energy and maintenance costs.
- *Note: The fan coil units in A-Wing of Lewis Parker are due to be replaced in the summer of 2009.*

ECM #17: VFDs on Hot/Chilled Water System Pumps

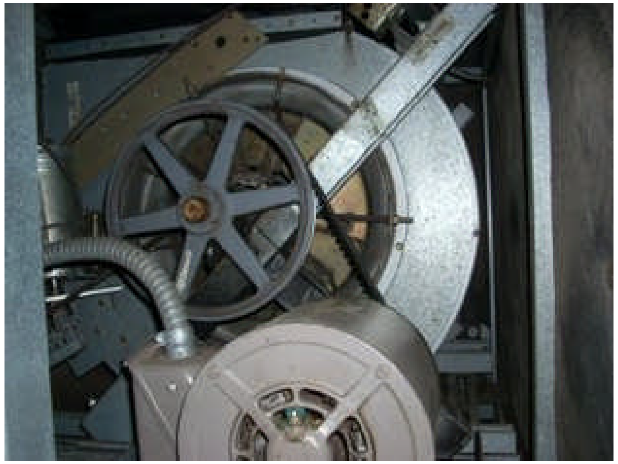
Central Plant	
Estimated Annual Energy Cost Savings:	$6,500
Gross Estimated Implementation Cost:	$95,740
NJ Smart Start Rebate:	$6,000
Net Estimated Implementation Cost:	$89,740
Simple Payback (years):	13.8
Annual Avoided CO_2 Emissions (tons):	14

- The primary hot water (5 hp, 30 hp & 40 hp) and chilled water (50 hp) pumps in the Central Plant are equipped with constant speed motors. The pumps operate in online / standby mode.
- The pumps run at full speed regardless of system hot/chilled water demands.
- Annual system pumping cost may be reduced by installing variable frequency drive (VFD) on the pump motors. Pump speed would vary based upon system differential temperature/pressure.
- The installation cost estimates assume replacing the motors with inverter-duty motors, and installing VFDs on all pump motors. A majority of chilled water and hot water end users are equipped with 2-way control valves. The end users with 3-way valves will have to be replaced with 2-way valves.
- Equipping the primary chilled water pumps with VFDs assumes the current chillers would be replaced with variable flow chillers – vari-prime chilled water system.

ECM #18: Convert Supply Fan Vortex Control to VFDs

Academic Building	
Estimated Savings:	$2,840
Gross Estimated Implementation Cost:	$44,480
NJ Smart Start Rebate:	1,800
Net Estimated Implementation Cost:	$42,680
Simple Payback (years):	15.0
Annual Avoided CO_2 Emissions (tons):	6

- The air handlers (AHU-2, 6, 8 & 9) supply air to a variable air volume system. The fan air flow is controlled by vortex dampers located at the fan.
- Vortex fan control is an effective and energy-efficient method of controlling fan air flow. However, controlling fan speed with a variable frequency drive will improve control and provide twice the energy savings.
- This ECO requires replacement of the motors as well as installation of the VFD's. Savings include upgrading motors to high efficiency models.



Air Handling Unit w/ Vortex Dampers

ECM #19: Instantaneous Domestic Hot Water Systems

Central Plant	
Estimated Annual Energy Cost Savings:	$2,320
Estimated Gross Implementation Costs:	$36,100
NJ Smart Start Rebate:	$0
Net Estimated Implementation Costs:	$36,100
Estimated Simple Payback:	15.6
Annual Avoided CO_2 Emissions (tons):	8

- Currently, the approximately 500-gallon domestic hot water storage tank in the Central Plant provides hot water to the Physical Education building – restrooms and locker rooms.

- Although the tank is insulated, it experiences standby heat loss. Installing a packaged heat exchanger that is tied into the main hot water system will eliminate the standby heat loss. In essence, the heat exchangers provide instantaneous hot water.

- Dome-Tech recommends considering a packaged heat exchanger if and/or when the main boiler plant is upgraded.

ECM #20: Walk-In Cooler Controllers

	Lewis Parker Building
Estimated Savings:	$200
Gross Estimated Implementation Cost:	$3,650
NJ Smart Start Rebate:	$0
Net Estimated Implementation Cost:	$3,650
Simple Payback (years):	18.2
Annual Avoided CO_2 Emissions (tons):	0

- Typically the walk-in cooler evaporator fans run continuously. However, full airflow is only required 50% of the runtime.
- In the most common applications (those that use single-phase power), motors for the fans are typically shaded-pole or permanent-split-capacitor types, both of which are very inefficient.
- Inexpensive controllers are currently available that slow these fans when full-speed operation is unnecessary.
- Reducing the operating speed reduces the energy consumption of the fan. In addition, the motor produces less heat at slower speeds, which means that the compressor has less heat to remove from the refrigerated compartment.

ECM #21: Creation of an Energy Awareness & Education Program

- Burlington County College did not seem to have an energy awareness program in place.
- Educational institutions can have a potentially large impact on promoting an energy conscious and conservation-minded society that starts at their school, leading to energy cost reductions, environmental benefits, and national energy independence.
- In addition, schools can receive recognition for their efforts and possible media coverage, which can contribute to enhanced school spirit, and individual feelings of accomplishment and connection.

Estimated Annual Savings:	2-3%*
Gross Estimated Implementation Cost:	$1500 each
Expected Rebate / Energy Efficiency Credit:	None
Net Estimated Implementation Costs:	$1500
Simple Payback (yrs): (with and w/o rebate)	Varies
Annual Avoided CO_2 Emissions (tons):	Varies
Cost per Ton CO_2 Reduction ($/ton):	Varies

* Estimated Annual Savings are based on the robustness of the program implemented, maintenance, and annual energy costs.

Renewable/Distributed Energy Measures

Distributed Generation & Renewable Energy

- Distributed Generation (on-site generation) generates electricity from many small energy sources. These sources can be renewable (solar/wind/geothermal) or can be small scale power generation technologies (CHP, fuel cells, microturbines)

- Renewable energy is energy generated from natural resources (sunlight, wind, and underground geothermal heat) which are naturally replenished

- Photovoltaics (solar) are particularly popular in Germany and Spain and growing in popularity in the U.S.

- Wind power is growing as well, mostly in Europe and the U.S.

- Geothermal applications are used widely in western U.S. (most prominent in the Yellowstone basin and in northern California)

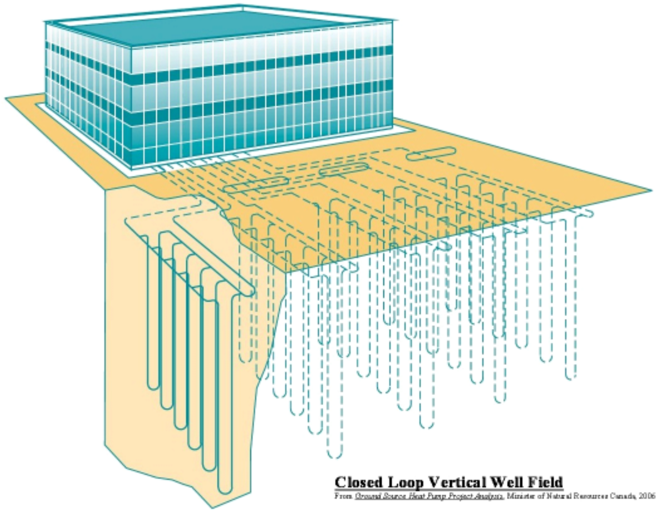
Renewable Energy Technologies: Geothermal

Geothermal ground source heat pump (GSHP) systems are HVAC systems that use the earth's relatively constant temperature to provide heating or cooling to a system. In doing so, GSHP systems move 3 to 5 times more energy between the building and the ground than is actually consumed by the system components. In comparison, this represents a 30% decrease in energy consumption when compared to conventional HVAC systems that required chillers or refrigeration coils for cooling and boilers or electric resistance coils for heating.

A GSHP system consists of three major components: the heat pump, the well field, and the heating/cooling distribution system.

Heat Pump

The heat pump is the driving force behind a GSHP system. A typical heat pump is an "air-to-water" unit, meaning the fluid carries heat to and from the earth (via the earth connection) is a water or water/antifreeze mixture, and the HVAC distribution system in the building distributes hot or cold air. Heat pumps are self-contained in a single enclosure and consist of a refrigerant compressor, earth heat sink heat exchanger, and an air distribution system (fan, refrigerant-to-air heat exchanger, and condensate removal). Heat pumps range in size between 1 to 30 tons. For larger facilities (such as schools and office buildings), several heat pump units are required.



Closed Loop Vertical Well Field
From *Ground Source Heat Pump Project Analysis*, Minister of Natural Resources Canada, 2006

Well Field

The well field provides the heat exchanging mechanism between the GSHP system water side and the earth. Well fields are either open or closed system. Open systems directly draw from an adjacent water source such as a lake or aquifer. Closed systems are typically polyurethane tubing buried in horizontal trenches or boreholes. The system selected for this analysis is a closed loop, horizontal well field. Wells are typically 250 to 500 feet deep each, and provide 1 ton of cooling for every 250 linear feet. Wells are spaced at 15 to 20 feet on center, and larger systems can have a significant footprint. In addition, the well boring portion of the project is capital intensive and usually accounts for over 50% of the total GSHP system cost. Once installed, and well field has a estimated equipment service life of over 50 years.

Heating/Cooling Distribution System

The heating/cooling distribution system consists of the ductwork used to supply conditioned air the building. As previously stated, larger facilities often require multiple heat pumps connected to a common building loop. Buildings equipped with GSHP's may also require make-up air units to provide fresh air to the spaces, as well as an auxiliary heat source (such as a boiler or steam heat exchanger) to supplement heating during high heating degree days.

Renewable Energy Technologies: Geothermal

Dome-Tech, Inc.

The project economics and GSHP pro's and cons are presented in the following tables:

GSHP Economics*

	GSHP	DX Roof Top
Gross Installation Cost Estimate	$861,000	$430,500
NJJ SSB Rebate	$45,510	$9,717
Net Installation Cost Estimate	$815,490	$420,783
Annual Energy Cost	$83,596	$109,493
Annual Electric Use, kWh	522,475	344,882
Annual Natural Gas Use, Therms	0	34,375
Annual CO2 Emmisions, Therms	183	322

*Based upon Burlington County College - Academic Building HVAC Systems & Energy

Simple Payback on Net Install Cost GSHP

Net Installation Cost Estimate	$815,490
Annual Energy Savings	$25,897
Simple Payback	31.5

Simple Payback on Incremental Cost of GSHP

Net Installation Cost Estimate	$394,707
Annual Energy Savings	$25,897
Simple Payback	15.2

GSHP Pros & Cons

Pros	Cons
➢Annual HVAC energy reduction of over 20% and energy spend by over $25,000. ➢Well fields installations typically last over 50 years. ➢Reduction of annual greenhouse gas emissions by 80 tons per year. ➢Potential for removal of boiler and chiller / low efficiency DX refrigeration system. ➢Potential for reduced maintenance costs if the GSHP system replaces a cooling tower or other equipment.	➢Payback period is longer than expected life of heat pump equipment (exclusive of well field). ➢Ground conditions are not always conducive to a well field installation. Conditions unknown until drilling is complete. ➢The well field requires a significant amount of real estate. In this case, well over an acre of land may be required depending on depth of well field.

A GSHP installation is not recommended as an immediate retrofit project. However, a detailed life cycle analysis of a GSHP system versus a traditional HVAC system is recommended once the existing equipment exceeds the estimated equipment service life.

Renewable Energy Technologies: Wind

Wind turbines generate electricity by harnessing a wind stream's kinetic energy as it spins the turbine airfoils. As with most renewable energy sources, wind energy is subject to intermittent performance due to the unpredictability of wind resources.

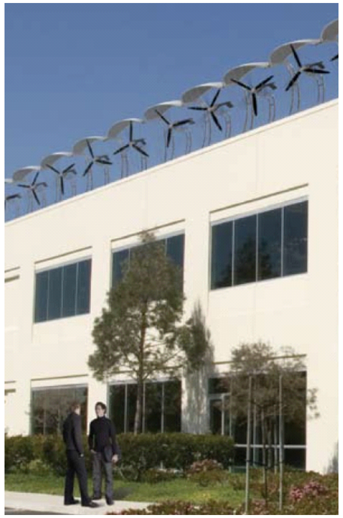
Wind Speed

As previously stated, wind speed is critical to the successful wind turbine installation. According to average wind data from NASA's Surface Meteorology and Solar Energy records, the average annual wind speed for the Pemberton area is 4.6 meters per second. Ideal wind speeds for a successful project should average over 6 meters per second.

For Burlington County College, Dome-Tech considered three (3) types of wind turbine technologies; building integrated wind turbines (1 kW each) and traditional ground mounted wind turbines (5 kW & 50 kW).

Building Integrated Wind Turbines

Model: AeroVironment AVX1000
Height: 8.5'
Rotor Diameter: 6'
Weight: 130 lbs.
Cut-In Wind Speed: 2.2 m/s
Maximum Generating Capacity: 1 kW



5 kW Ground Mount

Model: WES5 Tulipo
Height: 40'
Rotor Diameter: 16'
Weight: 1,900 lbs.
Cut-In Wind Speed: 3.0 m/s
Maximum Generating Capacity: 5.2 kW

50 kW Ground Mount

Model: Entegrity EW50
Height: 102'
Rotor Diameter: 50'
Weight: 21,000 lbs.
Cut-In Wind Speed: 4.0 m/s
Maximum Generating Capacity: 50 kW

Renewable Energy Technologies: Wind

The project economics and wind turbine pros and cons are presented in the following tables:

Wind Turbine Economics

	Building Integrated	Ground Mount 5 kW	Ground Mount 50 kW
Gross Installation Cost Estimate	$130,000	$62,400	$250,000
NJJ SSB Rebate	$45,278	$35,994	$95,720
Net Installation Cost Estimate	$84,722	$26,406	$154,280
Annual Energy Savings	$2,264	$1,800	$16,806
Simple Payback	37.4 yrs.	14.7 yrs.	9.2 yrs.
System Capacity	20 kW	10 kW	50 kW
Annual Avoided Energy Use	14,149 kWh	11,248 kWh	105,041 kWh
Annual CO2 Emmisions, Therms	5	4	37
% of Annual Electric Use*	0.2%	0.2%	1.7%

Burlington County Community College: 6007640 kWh/Year.

Wind Turbine Pros & Cons

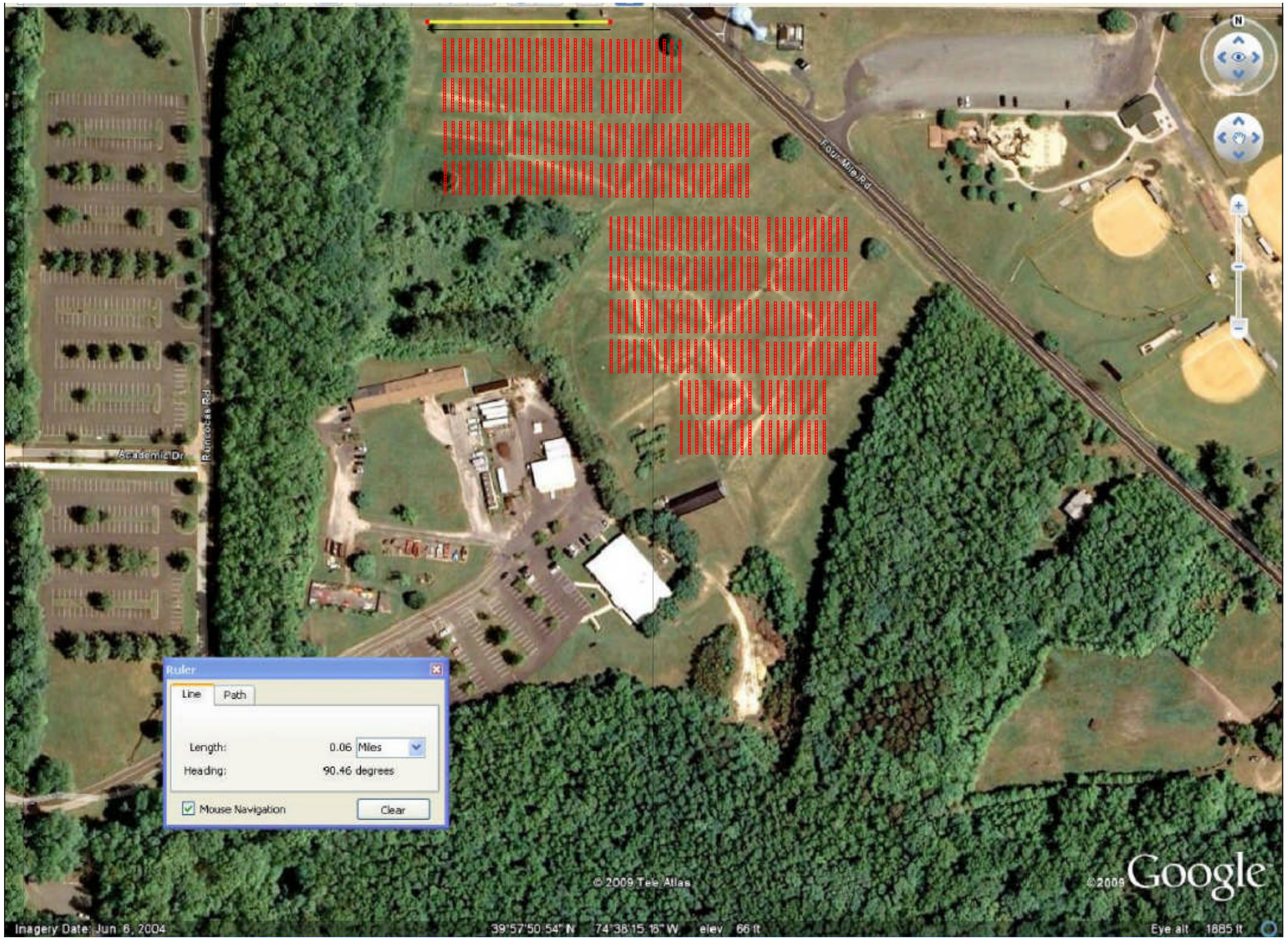
Pros	Cons
➢Annual reduction in energy spend and use can be potentially reduced by over $16,000 (1% reduction). ➢Typical equipment life span is 15-30 years. ➢Reduction of annual greenhouse gas emissions by 4-37 tons per year. ➢A wind turbine project could be incorporated into science and other curriculums to raise student awareness of energy alternatives. ➢High visible “green” project.	➢Payback period is significant (over 10 years). ➢Average area wind speed is not ideal and impacts performance. ➢Prone to lighting strikes. ➢Bird collisions are likely, but may be reduced with avian guard (building integrate only). ➢Zoning may be an issue. Check with local zoning regulations. ➢Wind turbines do create noise, although below 50 dB (a typical car ride is over 80 dB).

Should the Burlington County Community College decide to pursue a wind turbine project, Dome-Tech recommends commissioning a more detailed study.

Solar Photovoltaic

- Sunlight can be converted into electricity using photovoltaics (PV).
- A solar cell or photovoltaic cell is a device that converts sunlight directly into electricity.
- Photons in sunlight hit the solar panel and are absorbed by semiconducting materials, such as silicon. Electrons are knocked loose from their atoms, allowing them to flow through the material to produce electricity.
- Solar cells are often electrically connected and encapsulated as a module, in series, creating an additive voltage. The modules are connected in an array. The power output of an array is measured in watts or kilowatts, and typical energy needs are measured in kilowatt-hours.
- Can be recommended in this application for placement on additional buildings or open areas.

Renewable Energy Technologies: Solar Photovoltaic



Renewable Energy Technologies: Solar Photovoltaic

System Capacity, kw-dc	1,110 kw dc
Annual Electric Generation, kwhrs of AC electricity produced	1,387,500 kwh
Total Annual Facility Electric Use, kwhrs	6,007,640 kwh
% of Total Annual Usage	23%
All-In Cost of Electric Year 1	$0.160 / kwh
Annual Electric Cost Savings	$222,000
Estimated SREC Value (Year 1):	$640 / SREC
Estimated Year 1 SREC Revenue:	$887,542
Equivalent Annual CO2 Emission Reduction (tons per year)[1]	458 tons/yr
Equivalent Cars Removed From Road Annually[2]	79
Equivalent Acres of Trees Planted Annually[3]	125
System Installed Cost (does not include value of tax credits)	$8,325,000
Simple Payback (includes tax incentives)	8.7
IRR (25 Years)	9%

1. Estimated CO2 Emissions Rate: 0.66 lbs/kWh

2. EPA Estimate: 11,560 lbs CO2 per car

3. EPA Estimate: 7,333 lbs CO2 per acre of trees planted

Solar Photo Voltaic System

Non-Financial Benefits of Solar PV

The implementation of solar PV projects places Burlington County College at the forefront of renewable energy utilization. This allows the College the opportunity to not only gain experience with this energy technology, but also to win recognition as an environmentally sensitive, socially conscience institution. Additionally, these projects could be incorporated into science education and additional curriculums to raise awareness of current energy alternatives to the younger generations.

Renewable Energy Technologies: CHP/Cogeneration

- CHP (combined heat and power) or cogeneration is the use of a heat engine to simultaneously generate both electricity and useful heat.
- Fuel Cells are electrochemical conversion devices that operate by catalysis, separation the protons and the electrons of the reactant fuel, and forcing the electrons to travel through a circuit to produce electricity. The catalyst is typically a platinum group metal or alloy. Another catalytic process takes the electrons back in, combining them with the protons and oxidant, producing waste products (usually water and carbon dioxide).
- Microturbines are rotary engines that extract energy from a flow of combustion gas. They can be used with absorption chillers to provide cooling through waste heat rather than electricity. Microturbines are best suited for facilities with year-round thermal and/or cooling loads.
- Not recommended for Burlington County College due to the lack of around-the-clock electrical load and thermal requirements.

Utility Tariff and Rate Review: Electricity

- **Accounts and Rate Class:** The campus is served by six electric accounts behind Jersey Central Power & Light under rate class General Service Secondary. The East Campus does not have an electric meter.

- **Electric Consumption and Cost:** Based on the one-year period studied, the total annual electric expenditure for the College is about $973,000 and the total annual consumption is about 6,000,000 kilowatt-hours (kWh).

- **Average/Effective Rate per kWh:** For the one year period studied, the College's average monthly cost per kilowatt-hour ranged from 13.70 ¢/kWh to 18.44 ¢/kWh, inclusive of utility delivery charges. The College's overall, average cost per kilowatt-hour during this period was 16.34 ¢/kWh.
  - Note that these average electric rates are "all–inclusive"; that is, they include all supply service (generation and commodity-related) charges, as well as all delivery service charges. The supply service charges typically represent the majority (60-80%) of the total monthly bill. It is the supply portion of your bill that is deregulated, which is discussed on subsequent slides in this section.

Utility Tariff and Rate Review: Natural Gas

- **Accounts and Rate Class:** The College's PE Building & Central Plant and East Campus are each served by one single natural gas account behind Public Service Electric and Gas Company under rate class Basic Gas Supply Service-General Service (BGSS-GSG).

- **Natural Gas Consumption and Cost:** Based on the one-year period studied, the total annual natural gas expenditure for the College is about $425,000 and the total annual consumption is about 265,000 therms (th). Natural gas is used predominantly throughout the winter period for heating purposes.

- **Average/Effective Rate per Therm:** For the one year period studied, the College's average cost per therm ranged from $1.58 to $1.84 per therm, inclusive of utility delivery charges. The College's overall, average cost per therm during this period was $1.71 per therm.
  - Note that these average natural gas rates are "all–inclusive"; that is, they include all supply service (interstate transportation and commodity-related) charges, as well as all delivery service charges. The supply service charges typically represent the majority (60-80%) of the total monthly bill. It is the supply portion of your bill that is deregulated, which is discussed on subsequent slides in this section.

Utility Deregulation in New Jersey: Background and Retail Energy Purchasing

- In August 2003, per the Electric Discount and Energy Competition Act [N.J.S.A 48:3-49], the State of New Jersey deregulated its electric marketplace thus making it possible for customers to shop for a third-party (someone other than the utility) supplier of retail electricity.
- Per this process, every single electric account for every customer in New Jersey was placed into one of two categories: BGS-FP or BGS-CIEP. BGS-FP stands for Basic Generation Service-Fixed Price; BGS-CIEP stands for Basic Generation Service-Commercial and Industrial Energy Pricing.
- At its first pass, this categorization of accounts was based on rate class. The largest electric accounts in the State (those served under a Primary or a Transmission-level rate class) were moved into BGS-CIEP pricing. All other accounts (the vast majority of accounts in the State of New Jersey, including residential) were placed in the BGS-FP category, receiving default electric supply service from the utility.
- The New Jersey Board of Public Utilities (NJBPU) has continued to move new large energy users from the BGS-FP category into the BGS-CIEP category by lowering the demand (kW) threshold for electric accounts receiving Secondary service. Several years ago, this threshold started at 1,500kW; now, it has come down to 1,000 kW. So, if an account's "peak load share" (as assigned by the utility) is less than 1,000 kW, then that facility/account is in the BGS-FP category. If you are unsure, you may contact Dome-tech for assistance.

Utility Deregulation in New Jersey: Background and Retail Energy Purchasing (cont.)

- There are at least 3 important differentiating factors to note about each rate category:
  1. The rate structure for BGS-FP accounts and for BGS-CIEP accounts varies.
  2. The “do-nothing” option (ie, what happens when you don’t shop for retail energy) varies.
  3. The decision about whether, and why, to shop for a retail provider varies.

- Secondary (small to medium) Electric Accounts:
  - BGS-FP rate schedules for all utilities are set, and re-set, each year. Per the results of our State’s BGS Auction process, held each February, new utility default rates go into effect every year on June 1st. The BGS-FP rates become each customer’s default rates, and they dictate a customer’s “Price to Compare” (benchmark) for shopping purposes. To learn more about the BGS Auction process, please go to www.bgs-auction.com.
  - A customer’s decision about whether to buy energy from a retail energy supplier is, therefore, dependent upon whether a supplier can offer rates that are lower than the utility’s (default) Price to Compare. In 2009, and for the first time in several years, many BGS-FP customers have “switched” from the utility to a retail energy supplier because there have been savings.

- Primary (large) Electric Accounts:
  - The BGS-CIEP category is quite different. There are two main features to note about BGS-CIEP accounts that do not switch to a retail supplier for service. The first is that they pay an hourly market rate for energy; the second is that these accounts also pay a “retail margin adder” of $0.0053/kWh. For these large accounts, this retail adder can amount to tens of thousands of dollars. The adder is eliminated when a customer switches to a retail supplier for service.
  - For BGS-CIEP accounts, the retail adder makes a customer’s decision about *whether* to switch relatively simple. However, the process of setting forth a buying strategy can be complex, which is why many public entities seek professional assistance when shopping for energy.
  - For more information concerning hourly electric market prices for our region, please refer to www.pjm.com.

Utility Deregulation in New Jersey: Background and Retail Energy Purchasing (cont.)

- Natural Gas Accounts:
  - The natural gas market in New Jersey is also deregulated. Unlike the electric market, there are no “penalties”, or “adders”, for not shopping for natural gas. Most customers that remain with the utility for natural gas service pay rates that are market-based and that fluctuate on a monthly basis. While natural gas is a commodity that is exceptionally volatile and that is traded minute-by-minute during open trading sessions, market rates are “settled” each month, 3 business days prior to the subsequent month (this is called the “prompt month”). Customers that do not shop for a natural gas supplier will typically pay this monthly settlement rate to the utility, plus other costs that are necessary to bring gas from Louisiana up to New Jersey and ultimately to your facility.
  - For additional information about natural gas trading and current market futures rates for various commodities, you can refer to www.nymex.com.
  - A customer’s decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by enlisting a retail natural gas supplier. Many larger natural gas customers also seek the assistance of a professional consultant to assist in their procurement process.

Retail Energy Purchasing: Recommendations and Resources

- Electric
  - Based on current and recent market conditions, and actual bid processes run by Dome-Tech for various clients during the summer of 2009, we have seen customers with BGS-FP accounts save approximately 10-20% in projected energy costs by switching to retail energy supplier. The College was able to secure this type of agreement with the NJ County College Electric Consortium. This will represent an annual savings of approximately $40,000 for the College. It is important to note that actual rates and potential savings will be dependent on several factors, including market conditions, account usage characteristics/load profile (load factor), volume, and contract term.

- Natural Gas
  - Based on current and recent market conditions, and actual bid processes run by Dome-Tech for various clients during the summer of 2009, we have seen many customers entering into longer-term contracts for fixed natural gas rates. These rates vary substantially based on load type, volume, and term.

- Energy Purchasing Co-Operatives
  - Many public entities participate in various energy aggregation buying groups. Sometimes, an entity will have multiple options to choose from. These might include purchasing through a County co-operative, or purchasing through a trade-type association (for instance, many schools participate in NJASBO's ACES program). Co-operative purchasing may not necessarily get you the lowest rates; however, there is often substantial volume, and it can represent a good alternative for entities with limited energy consumption who can have a difficult time getting energy suppliers to respond to them on a direct, singular basis.

- To determine whether a savings opportunity currently exists for your entity, or for guidance on how to get started, you may contact Dome-Tech to discuss. There is also additional information provided below.

Retail Energy Purchasing: Recommendations and Resources (cont.)

Dome-Tech, Inc.

- To learn more about energy deregulation, visit the New Jersey Board of Public Utilities website: www.bpu.state.nj.us
- For more information about the retail energy supply companies that are licensed and registered to serve customers in New Jersey, visit the following website for more information: http://www.bpu.state.nj.us/bpu/commercial/shopping.html
- Provided below is a list of NJ BPU-licensed retail energy suppliers:

Company	Electricity	Natural Gas	Website
Pepco	X	X	www.pepcoenergy.com
Hess	X	X	www.hess.com
Sprague	X	X	www.spragueenergy.com
UGI	X	X	www.gasmark.com
South Jersey Energy	X	X	www.sjindutries.com
Direct	X	X	www.directenergy.com
Global	X	X	www.globalp.com
Liberty	X		www.libertypowercorp.com
ConEd Solutions	X		www.conedsolutions.com
Constellation	X		www.constellation.com
Glacial	X		www.glacialenergy.com
Integrys	X		www.intergryenergy.com
Suez	X		www.suezenergyna.com
Sempra	X		www.semprasolutions.com
Woodruff		X	www.woodruffenergy.com
Mx Energy		X	www.mxenergy.com
Hudson		X	www.hudsonenergy.net
Great Eastern		X	www.greateasterngas.com

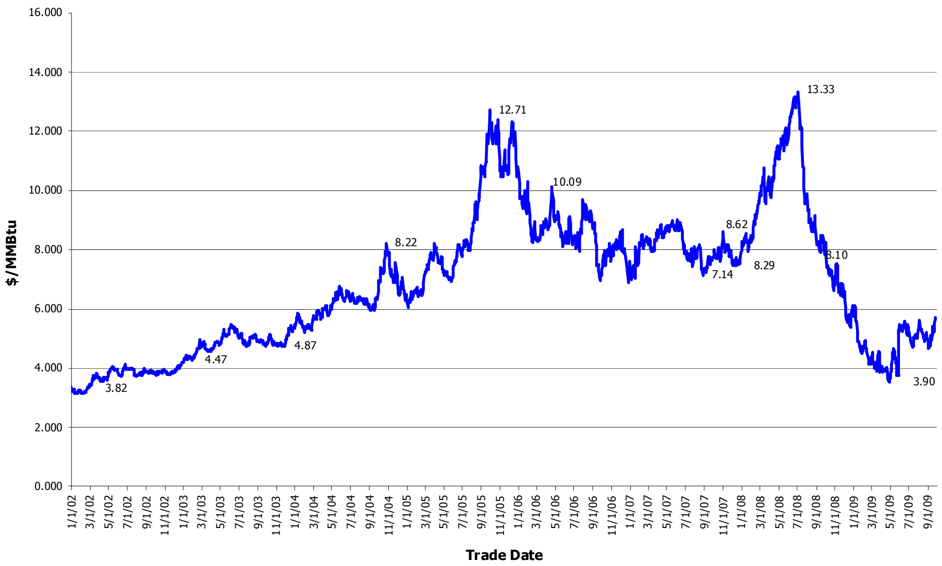
**Note: Not every Supplier serves customers in all utility territories within New Jersey*

Historical Energy Futures Settlement Prices

Dome-Tech, Inc.

- Below please find graphs that show the last several years' worth of market settlement prices for both natural gas and electricity. Each of these graphs shows the average closing prices of a rolling 12-month period of energy futures prices. The graphs are representative of the commodity, alone; they do not include any of the additional components (capacity, transmission, ancillary services, etc.) that comprise a retail energy price. They are meant to provide an indication of the level of pricing that a particular customer might expect to see, but the graphs do not account for the specific load profile of any individual energy user.

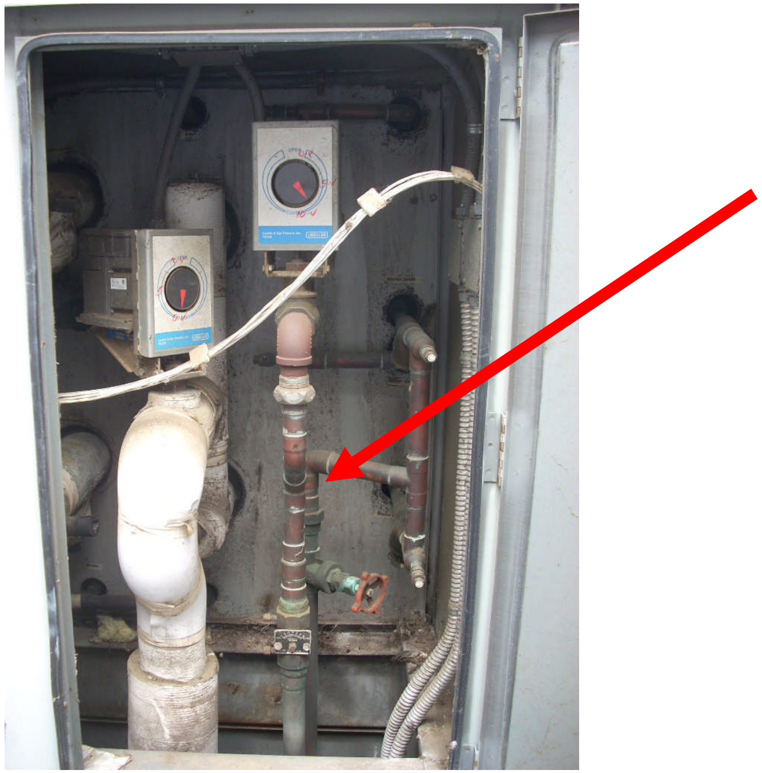
Henry Hub 12 month strip



PJM West 12 month strip

Operations & Maintenance

- <u>Issue:</u> Uninsulated hot water pipe in pipe chase of AC-3 on lower Library roof.
- <u>Impact:</u> Radiant heat loss from pipe leads to excess energy consumption.
- <u>Recommendation:</u> Install pipe insulation.



AC-3 located on lower roof of Integrated Resource Center

Potential Project Funding Sources

Through the NJ Clean Energy program, the New Jersey Board of Public Utilities currently offers a variety of subsidies or rebates for many of the project types outlined in this report. More detailed information can be found at: www.njcleanenergy.com

NJ Smart Start Buildings – Equipment Rebates noted in ECMs where available.
Equipment Rebates - Water Heaters, Lighting, Lighting Controls/Sensors, Chillers, Boilers, Heat pumps, Air conditioners, Energy Mgmt. Systems/Building Controls, Motors, Motor-ASDs/VSDs, Custom/Others
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

Renewable funding for PV & wind, plus federal credits currently available:
http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program/for-customers/application-forms

Clean Energy Solutions Capital Investment Loan/Grant

The EDA offers up to $5 million in interest-free loans and grants to promote the concept of "going green" in New Jersey. Under this program, scoring criteria based on the project's environmental and economic development impact determines the percentage split of loan and grant awarded. Funding can be used to purchase fixed assets, including real estate and equipment, for an end-use energy efficiency project, combined heat and power (CHP or cogen) production facility, or new state-of-the-art efficient electric generation facility, including Class I and Class II renewable Energy.
http://www.njeda.com/web/Aspx_pg/Templates/Npic_Text.aspx?Doc_Id=1078&menuid=1360&topid=722&levelid=6&midid=1357

Next Steps

The following projects should be considered for further study and implementation:

- Reprogram CFM Setpoints
- Replace chillers
- Lower Pool Water Temperature
- Replace Boilers
- Replace unit Heaters with Infrared Radiant Heaters
- Install Premium Efficient Motors
- Lighting upgrade
- Start an Energy Awareness and Education Program
- Install ground-mounted photovoltaic system

Note that additional "Phase 2" engineering will be required to further develop these projects, to bring them to bidding and implementation.